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AUTHOR Smith, William Earl
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ABSTRACT

This review of the literature on reading theories is built around three components: an explication of each theory, an evaluation of the theory based on an examination of its internal and external coherence and correspondence, and an application of the theory to a child's reading. The literature is organized around discussions of 12 benchmarks extracted from the literature, with each discussion followed by a list of references from which the conclusions were drawn. The discussed benchmarks suggest that theories of reading must (1) explain the interactive and variable processes involved in eye fixations and movements, (2) provide for optional grapheme to phoneme recoding, (3) provide for the processing involved in word recognition, (4) specify the use of syntactic and semantic information, (5) provide for the use of world knowledge in the construction of meaning, (6) provide for the interaction of the multiple levels of operation used by the reader in constructing meaning, (7) provide for the coordination of the multiple contributors to the reading process, (8) provide for parallel processing, (9) provide for the degree of utilization of each process, (10) provide for the role of memory in the reading process, (11) provide for the various levels of proficiency, and (12) provide for the various types of reading. (HOD)

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Twelve Benchmarks for the Evaluation of Reading Theories:
A Review of Literature

By
William Earl Smith
Assistant Professor
Western Kentucky University
Bowling Green, Kentucky

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Twelve Benchmarks for the Evaluation of Reading Theories: A Review of Literature

The review of literature reported on today is the result of a study in which six theories of reading were examined and evaluated. The examination, adapting Dr. Elizabeth Steiner's model for theory evaluation, included three components: (1) An explication of the theory, (2) An evaluation of the theory based on an examination of the theory's internal and external coherence and correspondence, and (3) An application of the theory to a child's reading.

In explicating the theory, all theoretical terms were identified and defined and their relationships established. Internal coherence was then examined through a study of terms and primitive terms, checking to see that the terms cohere with each other, that there are no missing parts, and that there are no contradictions. External coherence was examined to compare the fitness of the theory to other theories, as one theory often borrows from another in explaining a phenomenon. An example of this is the tendency of reading theories to borrow from the linguistic concepts of surface and deep structures or to draw upon semantic theories in discussing reading. In such cases, these borrowed terms should fit; they should be appropriately used.

When examining correspondence, the theory was examined for fitness to the data. Does the theory fit what the data say about the phenomenon? An examination of the theory's external coherence and correspondence was performed by conducting a review of literature in reading as well as in related areas. From that review, a series of benchmarks that a theory of reading must address were extracted.

The application of the theory was done by sending to the authors of each of the theories a tape of a child's reading and retelling of a story. Each theorist was then asked to respond to the reading and a series of questions about the reading. The theorists asked to respond were: Samuels, Singer, Gough, Goodman, Beaugrand, and Rumelhart. Initial contact was made during 1979. With the exception of Singer, each author re-

sponded. Dr. Singer suggested that Dr. Martin Kling be contacted. In March of 1980, Dr. Kling kindly agreed to represent Dr. Singer's substrata factor theory.

Today I will present the findings of the review of literature and apply those findings to two of the models. Gough's and Goodman's models will be used, as they express two completely different theoretical views and represent opposite ends of the theoretical spectrum.

Because of the scope of a review of the literature dealing with all the aspects of reading, this review was necessarily limited. Researchers, if they feel that different or additional literature should be examined to establish criteria for coherence, may themselves use that literature to establish and apply their own data or set of criteria to the theories--thereby making their own decisions, based on their own value systems, as to which theory best represents the phenomenon.

This review is organized around the twelve benchmarks extracted from the literature. Following each discussion can be found a list of references from which the conclusions were drawn. The references are only representative of the material reviewed and are not intended to be comprehensive.

Benchmark I

A theory of reading must be able to explain the interactive and variable processes involved in eye fixations and movements.

Research lends credence to the assumption that eye movements are controlled by the brain. The eyes only take in the data; the brain works with it. However, the underlying assumption in eye movement research is that the eyes reflect what the brain is doing, and the brain's task is to derive meaning from the visual stimulation.

Fixation and saccadic movements vary with both the reader and the text, as they also do with age and purpose for reading. Most interesting to this issue, however, is the fact that eye movements do not just happen--there is no preprogrammed rhythmic movement of the eyes. Rather, the movement of the eyes from one point to another is based on the information the brain receives from previous fixations. Based on that information, the brain tells the eyes both when and where to move in the text. The basic sources of knowledge for these decisions appear to be: (1) Visual

input, (2) linguistic knowledge, and (3) world knowledge.

REFERENCES

- Buswell, G. T. Fundamental reading habits: A study of their development. Educational Monograph Supplement, 1922, 21.
- Buswell, G. T. A laboratory study of the reading of modern foreign languages. New York: Macmillan, 1928.
- Buurman, R. D., Roersema, T., & Gerrissen, J. F. Eye movement and the perceptual span in reading. Reading Research Quarterly, 1981, 16, 2, 227-235.
- Cohen, K. M. Eye movement in the study of the reading process. Models of efficient reading. Ed. by K. Cohen, R. F. West, and George March. Newark, Delaware: International Reading Association, 1978.
- Gilbert, L. C. Functional motor efficiency of the eyes and its relation to reading. University of California Publications in Education, 1953, 11, (3), 159-232.
- Hochberg, D. G. Acquisition of rapid reading responses. Society for Research in Child Development, 1976, 41, monograph 165.
- Just, M. A., & Carpenter, P. A. A theory of reading: From eye fixations to comprehension. Psychological Review, July 1980, 87, (4), 329-354.
- Kolers, P. A. Buswell's discoveries. In R. A. Monty & J. W. Senders, (eds.), Eye movement and psychological processes. New Jersey: Erlbaum, Hillsdale, 1976.
- McConkie, G. W. & Royner, K. The span of the effective stimulus during fixations in reading. Perception and Psychophysics, 1975, 17, 578-586.
- Marsh, G. The HIP approach to reading. In K. M. Cohen, R. F. West, & G. Marsh (Eds.), Models of efficient reading. Newark, Delaware: International Reading Association, 1978.
- Rayner, K. The perceptual span and peripheral cues in reading. Unpublished doctoral dissertation. Cornell University, 1974.
- Smith, F. Understanding reading. New York: Holt, Rinehart, and Winston, 1978.
- Smith, F. Reading without nonsense. New York: Teachers College, Columbia University, 1979.
- Stennett, R. G., Smythe, P. C., Pinkney, J., & Fairbairn, A. The relationships of eye movement measures to psychomotor skills and other elemental skills involved in learning to read. Journal of Reading Behavior, 1972-1973, 5, (1), 1-13.

Taylor, S. Eye movements in reading: Facts and fallacies. American Educational Research Journal, 1965, 2, 187-202.

Tinker, M. A. Recent studies of eye movement in reading. Psychological Bulletin, 1958, 55, 215-231.

Benchmark II

A theory of reading must provide for optional grapheme to phoneme recoding

Buswell addressed this issue in 1937 when he set out to show that oral reading was not simply silent reading with voice added. Since then, many other researchers have addressed this subject. Two lines of evidence are frequently presented in support of the grapheme-to-phoneme path to meaning. (1) Children's first language activity requires meaning in oral language; to have this, they are required to extract meaning from sound. When learning to read, these skills are possibly mapped onto visual symbols. (2) A growing wealth of data shows that even the mature reader demonstrates subvocalization during silent reading. Riley and Lowe (1981) present an excellent review of this literature. They point out that such activities are observed not only during silent reading but also during such activities as thinking, hallucinating, handwriting, conversational and visual dreaming, phonemic processing, and verbal learning.

Marsh (1978) states that

. . . visual familiarity is often confounded with phonemic encoding Studies which claim to unconfound these factors tend to use tasks which are far removed from reading for meaning. . . . It appears that the closer the research task gets to normal reading, the greater the influence of speech processes in reading.

A second position is represented by those researchers who feel that the reader goes directly from graphemic representation to meaning.

A third position taken is that phonemic recoding is optional. The research is rather inconclusive. The greater number of researchers read were unwilling to take a stand on either side but rather chose merely to suggest one position over another. Most researchers tend toward a middle-

of-the-road position and suggest that phonological recoding is an optional process: The reader may go either from print to meaning or from print to phonology to meaning.

REFERENCES

- Barron, R. W. Access to the meaning of printed words: Some implications for reading and for learning to read. In L. C. Ehri, R. W. Barron, & J. M. Feldman (Eds.), The recognition of words. Newark, Delaware: International Reading Association, 1978.
- Cohen, K. M. Eye activity in the study of the reading process. In Cohen, West, and Marsh, Models of efficient reading. Newark, Delaware: International Reading Association, 1978.
- Ehri, L. C. Beginning reading from a psycholinguistic perspective: Amalgamation of word identities. In L. C. Ehri, R. W. Barron, & J. M. Feldman, The recognition of words. Newark, Delaware: International Reading Association, 1978.
- Feldman, J. M. Wh* n**ds v*w*ls? In Ehri, Barron, and Feldman The recognition of words. Newark, Delaware: International Reading Association, 1978.
- Kolers, P. A. Buswell's discoveries. In R. A. Monty & J. W. Senders (Eds.), Eye movement and psychological processes. Hillsdale, New Jersey: Erlbaum, 1976.
- Marsh, G. The HIP approach to reading. In K. M. Cohen, R. F. West, & G. Marsh. Models of efficient reading. Newark, Delaware: International Reading Association, 1978.
- Riley, J. A., Lowe, J. D. Jr. A study of enhancing vs. reducing subvocal speech during reading. Journal of Reading, 1981, 25, (1), 7-13.

Benchmark III

A theory of reading must provide for the processing involved in word recognition.

There is little disagreement that reading involves word recognition as part of the process. However, how this is accomplished is quite another question. Opposite ends of the theoretical spectrum are represented by two different views of the results of word recognition: (1) That word

recognition means that the reader can determine the oral equivalent of a written or printed word and understand the intended meaning of a printed word. (2) That word identification is a function performed by the reader to confirm what he/she has already understood. Comprehension governs the identification of words.

Traditionally there have been three major areas of emphasis attempting to explain the process of word recognition: (1) Theories that assume a letter-by-letter analysis of words, (2) Theories that assume that words are recognized as wholes, and (3) Theories that assume that units larger than letters but smaller than words are the elements of analysis. Smith (1978) has provided an excellent summary and discussion of the three basic positions.

It appears that readers are able to attend to whatever part of the print they wish to in order to recognize words, one time attending to letters, another time taking in whole words, and at times perhaps even skipping words and still attaining meaning. Smith suggests that what is needed is a theory that "will not be incompatible with any of the data, but will also offer an explanation for inadequate aspects of the three traditional views." It appears that none of the three popular categories of word recognition theories is adequate, as each lacks the capability of explaining completely the phenomenon of word recognition. In short, any theory of reading that relies on the traditional views concerning word recognition will fall short of being an adequate explanation. Any serious attempt to understand reading must be able to explain why it might sometimes appear that words are identified as wholes and at other times through the identification of component letters or groups of letters.

REFERENCES

- Anderson, I. H., & Dearborn, W. F. The psychology of teaching reading. New York: Ronald, 1952.
- Cosky, M. J. The role of letter recognition in word recognition. Memory and Cognition, 1976, 4, (2), 2-7, 214.
- Harris, A. I. & Sipay, E. How to increase reading ability. 7th ed. New York: Longman, 1978.

- Johnson, N. F. On the function of letters in word identification: Some data and a preliminary model. Journal of Verbal Learning and Verbal Behavior, 1975, 14, (1), 17-29.
- Kolers, P. A. Three stages of reading. In H. Levine & Joanna P. Williams, (Eds.), Basic Studies on Reading. New York: Basic Books, 1970.
- Kolers, P. A., & Katzman, M. T. Naming sequentially presented letters and words. Language and Speech, 1966, 9, (2), 84-95.
- Lott, D., & Smith, F. Knowledge of intra-word redundancy by beginning readers. Psychonomic Science, 1970, 19, (6), 343-344.
- Miller, G. A., Bruner, J. S., & Postman, L. Familiarity of letter sequences and tachistoscopic identification. Journal of Genetic Psychology, 1954, 50, 129-139.
- Newman, E. B. Speed of reading when the span of letters is restricted, American Journal of Psychology, 1966, 79, 272-278.
- Pearson, P. D., & Studdt, A. Effects of word frequency and contextual richness on children's word identification ability. Journal of Educational Psychology, 1975, 67, (1), 89-95.
- Pillsbury, W. B. A study in apperception. American Journal of Psychology, 1897, 8, 315-393.
- Reicher, G. M. Perceptual recognition as a function of meaningfulness of stimulus material. Journal of Experimental Psychology, 1969, 81, 275-280.
- Rumelhart, D. E., & Siple, P. Process of recognizing tachistosocopically presented words, Psychological Review, 1974, 81, 99-118.
- Smith, F. Understanding reading. 2nd ed. New York: Holt, Rinehart, and Winston, 1978.
- Smith, F., & Holmes, H. The independence of letter, word, and meaning identification in reading. Reading Research Quarterly, 1971, 6, (3), 394-415.
- Smith, F., Lott, D., & Cronnell, B. The effects of type size and case alteration on word identification. American Journal of Psychology, 1969, 82, (2) 248-253.
- Wheeler, D. D. Processes in word recognition. Cognitive Psychology, 1970, 1, 59-85.

Benchmark IV

A theory of reading must specify the use of syntactic and semantic information.

An ample number of studies indicate that readers are sensitive to syntactic cues in the text. Adams (1980) suggests that, because of the loss during reading of the many cues available during the listening process, reading requires greater syntactic sophistication. Even simply making poorer readers aware of phrase boundaries can improve reading comprehension.

A very compelling indication of the power of syntax lies in the miscue studies. Miscues are typically syntactically acceptable. Studies which show this range in their findings from 70% to 90%. When random guessing should generate syntactically acceptable miscues about 18% of the time, 70% is rather impressive.

Syntax alone, however, is not sufficient. Semantic information also plays an important role in reading. Word meaning cannot be ignored. When measuring the reaction time involved while subjects made lexical decisions about words, Rumelhart found that the time was significantly less when the two words were semantically related than when they were not.

To explain the phenomenon of meaning, it has been said that each word has a fixed meaning (semantics) and that the ordering and grammar (syntax) in the sentence combined with the meaning of each word gives meaning to the sentence. It seems self-evident that semantics and syntax are important and integral parts in the construction of meaning. A theory of reading must indeed account for their roles in the reading process. However, such a simplistic explanation is inadequate. Research shows that a close relationship exists between syntax, semantics, and world knowledge, discussed in Benchmark V.

REFERENCES

- Fodor, J. A., Bever, T. G., & Garrett, M. F. The psychology of language. New York: McGraw-Hill, 1974.
- Frege, G. The basic laws of arithmetic. Translated and edited, with an introduction by M. Furth. Los Angeles: University of California Press, 1967.
- Gleason, H. A. Linguistics and English grammar. New York: Holt, Rinehart, & Winston, 1965.
- Jenkinson, M. D. Comprehension and some linguistic fallacies. Unpublished. University of Alberta.

- Lyons, J. Introduction to theoretical linguistics. Cambridge, England: Cambridge University Press, 1971.
- Weber, R. M. First graders' use of grammatical context in reading. In H. Levin and J. T. Williams (Eds.), Basic studies in reading. New York: Basic Books, 1970.
- Weinstein, R., & Robinovitch, M. Sentence structure and retention in good and poor readers. Journal of Educational Psychology, 1971, 62, 25-30.

Benchmark V

A theory of reading must provide for the use of world knowledge (conceptual, pragmatic, and textual knowledge) in the construction of meaning.

The literature is full of examples where semantics and syntax alone are insufficient to explain meaning. A theory of reading must account for that complex interrelationship that exists between syntax, semantics, and world knowledge. As none remains constant, each must rely on the other two in order to construct meaning. Borrowing from Anderson and Shiffrin (1980), consider how your understanding of the word "kick" and the reference for the word "ball" change in each of the following three sentences; yet, the syntax remains constant:

1. The punter kicked the ball.
2. The baby kicked the ball.
3. The golfer kicked the ball.

The research is rather conclusive that our perceptions are affected by what we know. A theory of reading must address this. Sherif and Hovland (1961) and Sherif, Sherif, and Nebergall (1965) have shown the power of a reader's knowledge in affecting the interpretation of text. Statements that would be considered as neutral by someone without a particular belief or bias on an issue are typically perceived by the person with strong feelings as being statements in favor of the position opposite his own, while moderately favorable statements are judged to be more favorable. Bransford and Johnson (1973) studied the comprehension of text in which subjects lacked the appropriate background knowledge for understanding. By using selections in which there were insufficient cues to suggest an appropriate knowledge base from which to interpret the passage, they were

able to show that the passages--though written very coherently and simply--were very difficult to understand. However, once an appropriate world situation was suggested for the passage, the reader was able to understand the passage. Having to rely solely on word meaning and syntax was insufficient. Trabasso (1981), using the sentence, "Mary had a little lamb," very cleverly shows the need for world knowledge to be able to correctly interpret the sentence under different conditions.

The importance of pragmatic knowledge or the knowledge of setting and the use for which language is intended is well shown in a validation study by Carey, Harste, and Smith (1981). Here they show that in a situationally constrained condition, the subjects' interpretations of a text was affected by their situation, surroundings, and setting. Lyons (1977) provides an excellent discussion on the power of pragmatics when constructing meaning from a text.

Concerning knowledge of text structure, it has long been realized that stories have characteristic structures distinguishing them from other forms of prose. The first real interest in story characteristics was by the anthropologists; however, during the last few years, psychologists have been very interested in examining the relationships between text structure, comprehension, and recall of text. Frederikson (1972), Kintsch (1974), and Meyer (1975) have been very interested in the structural analysis of text. Researchers like Stein and Glenn (1978), Mandler and Johnson (1977), Rumelhart (1975), and Thorndyke (1977) have examined the effects of internal structures of stories (story grammars) and the relationship of those structures on comprehension.

REFERENCES

Conceptual Knowledge

- Adams, M. J. Failure to comprehend and levels of processing in reading. In R. J. Spiro, B. C. Bruce, and W. F. Brewer (Eds.), Theoretical issues in reading. Hillsdale, New Jersey: Erlbaum, 1980.
- Anderson, R. C., & Shiffrin, Z. The meaning of words in context. In R. J. Spiro, B. C. Bruce, and W. F. Brewer (Eds.), Theoretical issues in reading. Hillsdale, New Jersey: Erlbaum, 1980.
- Bransford, J. D., & Johnson, M. K. Consideration of some problems of comprehension. In W. G. Chase (ed.), Visual information processing, New York: Academic Press, 1973.

- Kolers, P. A. Three stages in reading. In H. Levin & J. T. Williams (Eds.), Basic studies in reading. New York: Basic Books, 1970.
- Rumelhart, D. E. Toward an interactive model of reading. Technical Report No. 56. Center for human information processing. San Diego: University of California, 1976.
- Sherif, C. W., Sherif M., and Nebergall, R. E. Attitude and attitude change: The social judgement-involvement approach. Philadelphia: Saunders, 1965.
- Schank, R. C. Identification of conceptualizations underlying natural language. In R. C. Schank and K. M. Cooby (Eds.), Computer models of thought and language. San Francisco: Freeman, 1973.
- Smith, F. Reading without nonsense. New York: Teachers College, Columbia University, 1979.
- Trabasso, T. On the making of inferences during reading and their assessment. In J. Guthrie (Ed.), Comprehension and teaching. Newark, Delaware: International Reading Association, 1981.

Pragmatic Knowledge

- Anderson, R., Reynolds, R., Schallert, D., & Goetz, E. Frameworks for comprehending discourse. American Education Research Journal, 1977, 14, (4), 376-381.
- Carey, R., & Harste, J. Comprehension as context: Toward reconstruction of a transactional theory of reading. In R. Turney and J. Mitchell (Eds.), Understanding readers' understanding. London: Longman, in press.
- Carey, R., Harste, J., & Smith, S. Contextual constraints and discourse processes: A replication study. Reading Research Quarterly, 1981, 16, (2), 201-211.
- Deihl, W. Functional literacy as a variable construct: An examination of attitudes, behaviors, and strategies related to occupational literacy. Unpublished doctoral dissertation, Indiana University, 1979.
- Harste, J., & Carey, R. Comprehension, a setting. In J. Harste and R. Carey (Eds.), New perspectives on comprehension. University monographs in language and reading studies. Bloomington, Indiana, 1979.
- Lyons, J. Semantics 1 and semantics 2. New York: Cambridge University Press, 1977.

Textual Knowledge

- Frederickson, C. H. Effects of task-induced cognitive operations on comprehension and memory processes. In R. O. Freedle and J. B. Carroll (Eds.), Language comprehension and the acquisition of knowledge. Washington, D. C.: Winston, 1972.
- Kintsch, W. The representation of meaning in memory. Hillsdale, New Jersey: Erlbaum, 1977.

- Mandler, J. M., & Johnson, N. S. Remembrance of things parsed: Story structure and recall. Cognitive Psychology, 1977, 9, 111-151.
- Moyer, B. J. F. The organization of prose and its effects on memory. New York: American Elsevier Publishing Co., Inc., 1975.
- Rumelhart, D. E. Notes on a schema for stories. In D. G. Bobrow & A. Collins (Eds.), Representation and understanding: Studies in cognitive science. New York: Academic Press, 1975.
- Stein, N. L., and Glenn, C. G. An analysis of story comprehension in elementary school children. In R. Freedle (Ed.), Discourse processing: Multidisciplinary perspectives. Hillsdale, New Jersey: Ablex, 1978.
- Thorndyke, P. W. Cognitive structures in comprehension and memory of narrative discourse. Cognitive Psychology, 1977, 9, 77-110.

Benchmarks VI, VII, VIII, and IX

- VI. A theory of reading must provide for the interaction of the multiple levels of operation used by the reader in constructing meaning.
- VII. A theory of reading must provide for the coordination of the multiple contributors to the reading process.
- VIII. A theory of reading must provide for parallel processing.
- IX. A theory of reading must provide for the degree of utilization of each processor.

It is not sufficient to show that the varying operational levels exist in the reading process. The effect of one level on the other implies an interactive process. It is obvious that lower order processes (i.e. letter and word recognition) can and frequently are affected by operations much higher in the operational structure (i.e., world knowledge). Although it is easy and convenient to discuss the various operations in an orderly fashion, it is obvious that they do not function in that way. A model of reading must allow for each operation not only to affect the operation next to it but also to provide the wherewithal to show how the processes interact in a totally integrated fashion.

Santa (1981) summarizes the contributions of several authors in the following words:

First, a cognitive psychologist would very likely take a multiple levels approach to comprehension. According to this view, comprehension takes place on several interacting levels. Finally, it is important to note that those advocating

cognitive models recognize that each level of comprehension is capable of influencing other levels. Comprehending a sentence depends upon understanding the words within the sentence. A less obvious but equally important conclusion is that "higher levels" of comprehension influence all lower levels. That is, a person's expectations and general knowledge can easily influence one's ability to understand a sentence or even a word. Similarly, a person's understanding of a paragraph will influence comprehension of each sentence which, in turn, will affect the understanding of each word in the sentence.

Adams (1980) had much the same thing to say:

Skilled reading depends on a host of perceptual, linguistic, and cognitive processes. The importance of each of these processes must be defined not only in terms of the work for which it is directly responsible, but also in terms of the support it must lend to other, higher and lower level processes in the system.

Closely related to the concept of interaction of processes is the concept of parallel processing. Just as reading can no longer be thought of as a linear process with each processor doing its job unaffected by the other processors in the system, it also can no longer be thought of as a serial process. The current notion of interactivity suggests the operation of several parallel processes. Reading now must be considered as parallel processing, wherein several operations may be carried out at one time. Rumelhart (1977) describes in detail just such a system.

As long as reading was considered a straight-forward, linear process, there was no real need for any type of coordination between the systems. However, with the realization that parallel, interactive processes are going on, it becomes obvious that they must be coordinated between the processors. How are decisions made as to what input information should be attended to? In what order do the processors operate? In what order should the information be attended to? What dictates whether higher order affects lower order processors or vice versa? Without some sort of coordination, the entire process of reading is very apt to turn into pandemonium. Interestingly, one of the pioneers in parallel processing models, Selfridge (1959), designed a model of parallel processing that he called Pandemonium.

Beaugrand (1981), in his criteria for models of reading, suggests

that the utilization of information by the various processors must be considered by a model of reading. Among the models he discusses, the utilization of information runs all the way from total utilization of information to a very light utilization, wherein only enough information is used to predict and confirm what the text is about. Smith (1978, 1979), provides convincing arguments in a discussion of the operations involved in reading that the brain operates in a very parsimonious manner, taking in as little information as possible and using as little information previously stored in memory as possible. It would appear that the processors prefer to use as little information as possible; in fact, Smith suggests that if all information were to be taken in and used, the results would be total confusion from the overload.

REFERENCES

- Adams, M. J. Failures to comprehend and levels of processing. In R. J. Spiro, B. C. Bruce, & W. F. Brewer (Eds.), Theoretical issues in reading comprehension. Hillsdale, New Jersey: Erlbaum, 1980.
- Beaugrand, R. Design criteria for process models of reading. Reading Research Quarterly, 1981, 16, (2), 261-315.
- Rosenblat, L. M. The reader, the text, the poem. Illinois: Southern Illinois University Press, 1978.
- Rumelhart, D. E. Introduction to human information processing. New York: John Wiley and Sons, 1977.
- Santa, C. M. Children's reading comprehension: A final word. In C. M. Santa & B. L. Hayes, (Eds.), Children's prose comprehension. Newark, Delaware: International Reading Association, 1981.

Benchmark X

A theory of reading must provide for the role of memory in the reading process.

It becomes apparent that reading (gaining meaning from text) is greatly affected by the reader's store of knowledge. If this is the case, then meaning is linked to memory. Consequently, a model of reading must

provide for the role of memory in reading and clarify the relationship between memory and meaning in the reading process.

Not only does memory provide the reader with a pool of information from which to draw in the construction of meaning, but it also must provide a working process whereby the reader is able to store information received from the text, from predictions being made, and from any additional information being worked with during the processing of print.

The nature of the contributions of memory to the reading process would then suggest that there must be a working memory or a working part of memory that is used for information that is being processed. This type of memory seems to be provided in the concept of short-term memory.

The need to draw upon world knowledge from the memory suggests that a semantic memory and episodic memory (possibly different types of long term memory) must be utilized in the reading process.

A third function of memory lies in the retrieval of information from memory. In his discussion of memory, Beaugrand points out that three main outlooks on the input and retrieval operations of memory seem to be prevalent in the literature: (1) An abstractive approach postulates that a processor merely extracts features or traces from the presentation and stores them away. Recall is done by reviving these traces of the original experiences. (2) The constructive approach assumes that the processor begins integrating stored knowledge immediately so that memory receives an expanded, modified version of the experience and presents this when recall is required. The third outlook, the reconstructive approach, suggests that further contributions are still entering the memory storage after the experience is stored in memory; recall is thus based on the current state of storage being assembled by means of a general organizational pattern.

REFERENCES

- Baddeley, A. D., and Patterson, K. The relation between long-term and short-term memory. British Medical Bulletin, 1971, 27, (3), 237-224.
- Bartlett, F. Remembering. Cambridge: Cambridge University Press, 1932.
- Beaugrand, R. Design criteria for process models of reading. Reading Research Quarterly, 1981, 16, (2), 261-315.

- Bransford, J., Barclay, R., & Franks, J. Sentence memory: A constructive vs. interpretative approach. Cognitive Psychology, 1972, 3, 193-209.
- Craik, F., and Lockhart, R. S. Levels of processing: A framework for memory research. Journal of Verbal Learning and Verbal Behavior, 1972, 11, 671-684.
- Lindsey, P. H., and Norman, D. R. Human information processing. New York: Academic Press, 1972.
- Gomulicki, B. Recall as an abstractive process. Acta psychologica, 1956, 12, 77-94.
- Neisser, U. Cognitive psychology. New York: Appleton-Century-Crofts, 1967.
- Norman, D. A. Memory and attention: An introduction to human information processing. 2nd ed. New York: Wiley, 1976.
- Ortony, A., & Anderson, R. On putting apples into bottles: A problem of polysemy. Cognitive Psychology, 1975, 7, 167-180.
- Schneider, W., & Shiffrin, R. M. Controlled and automatic human information processing: I. Detection, search, and attention. Psychological Review, 1977, 84, (1), 1-66.
- Shiffrin, R. M. Locus and role of attention in memory systems. In P. M. A. Rabbitt & S. Dornic (Eds.), Attention and performance V. New York: Academic Press, 1975.
- Shoben, E. J. Theories of semantic memory: Approaches to knowledge and sentence comprehension. In R. J. Spiro, B. C. Bruce, and W. F. Brewer (Eds.), Theoretical issues in reading comprehension. Hillsdale, New Jersey: Erlbaum, 1980.
- Smith, F. Understanding reading: A psycholinguistic analysis of reading and learning to read. 2nd ed. New York: Holt, Rinehart, and Winston, 1978.
- Spiro, R. Remembering information from text: The "state of schema" approach. In R. Anderson, R. Spiro, and W. Montague (Eds.), Schooling and the acquisition of knowledge. Hillsdale, New Jersey: Erlbaum, 1977.
- Tulving, E. and Thomson, D. M. Encoding specificity and retrieval processes in episodic memory. Psychological Review, 1973, 80, (5), 352-353.
- Tulving, E. & Watkins, M. J. Structure of memory traces, Psychological Review, 1975, 82, (4), 261-275.

Benchmarks XI, XII

A theory of reading must provide for the various levels of proficiency.

A theory of reading must provide for the various types of reading.

Benchmarks XI and XII come more as general inferences drawn from the literature than as the results of direct research questions. Smith (1979) spends quite a bit of time presenting information to convince his audience that reading is not unique. There are no special parts of the brain designed specifically for the purpose of reading. The brain uses the same processes for reading that it does for other similar activities. He writes:

There is nothing about reading that is unique as far as intellectual processes are concerned Reading makes no demands that the brain does not meet in the comprehension of speech and visually there is nothing in reading that the eyes and brain do not accomplish when we look around the room to locate an object or to distinguish one face from another.

Keeping this in mind, it seems logical to assume that these processes must be explained within the realm of a reading theory when they are applied to reading. As an example, Spiro and Tirre (1980) and Spiro, Tirre, Freebody, and DeLoache (1979) have found that some readers appear to rely more on text driven (bottom up) information, while others rely more on knowledge-driven (top down) information when reading. Interestingly, this was true for proficient adult readers as well as for children who were far less proficient. It would appear that the use of the processors differs from reader to reader; however, this different use does not call for different reading models. Rather, the readers differ in the amount of use and relative proportions of each of the processors. This would suggest, then, that one model should be comprehensive enough to cover all levels of proficiency.

This same argument can be extended to cover the various types of reading, where the reader may be doing close reading (in which case he is paying careful attention, trying to extract the greatest amount of meaning possible from the text and trying to place in memory as much information as possible) or he may be skimming or scanning (during which he is looking for the overall concepts presented in the text or looking for a piece of specific information). Again we see the same processors being used in different relative

proportions rather than a totally different process, suggesting that one theory of reading should be comprehensive enough to explain all types of reading.

REFERENCES

- Smith, F. Reading without nonsense. New York: Teachers College, Columbia University, 1979.
- Spiro, J. R., & Tirre, W. C. Individual differences in schema utilization during discourse processing. Journal of Educational Psychology, 1980, 72, 204-208.
- Spiro, R. J., Tirre, W. D., Freebody, P., & DeLoache, J. Reading style etiology and preferences for bottom-up versus top-down processes. Unpublished manuscript, 1979.

Coding System for Use in Evaluating Theories of Reading Against the Twelve Benchmarks

- + = is present in the model
- = is not present in the model
- + - = is possible in the model without damaging the model
- = is not possible in the model; only could be added by making major theoretical changes

The Benchmarks of Reading and the Gough Model of Reading

I. Eye Fixations and Movement

- + A. An important part of Gough's model.
- + B. Data presented by Gough is in agreement with much of the eye fixation and visual processing data.
- C. Does not provide for any interactivity between visual information, linguistic knowledge, and world knowledge in determining fixation points.
- + D. The scanner in Gough's model could be converted to an interactive processor for this purpose.

II. Grapheme-Phoneme Recoding

- + A. Gough's model provides for phonological recoding.
- + B. The decoder converts graphemic input into systematic phonemes. (Chomsky & Halle, 1968). The librarian then scans the lexicon, where the systematic phonemes are mapped onto words.
- C. The model provides no way of bypassing this operation; consequently, it is a mandatory operation in the model.
- D. To alter the model to provide for Benchmark II strikes at the very underpinnings of the model: "Reading is linguistic knowledge x decoding."

III. Word Recognition

- A. The model assumes a letter-to-word process in word recognition.
- + B. The model, with no strain, could be adapted to a more appropriate explanation of the process of word recognition.

IV. Syntax and Semantics

- + A. Merlin uses syntax and semantics in constructing meaning.

V. World Knowledge

- A. Gough does not address this issue.
- B. There are no components that allow for this.
 1. Primary memory is defined as "a small capacity buffer storage system . . ."
 2. The only part of the model that may contain long term memory is TPWSGWTAU.
 - a. Nothing is placed there until it is understood.
 - b. Consequently, any other information stored there cannot contribute to the understanding.
- C. No part of the model provides a way for world knowledge to be used. Its addition would represent a total theoretical change.

- VI. Interactivity
- + A. The way the model is set up, there could be interactivity between syntax and semantics when Merlin is searching them to derive meaning.
 - B. No interaction between any of the processes is suggested.
- VII. Process Coordination
- A. Because the model is linear, there is no need for coordination.
 - B. Its addition would be superfluous.
- VIII. Parallel Processes
- A. The model is linear; no two processes occur at the same time.
 - B. The addition of parallel processing would destroy the model.
- IX. Utilization
- A. Gough does not address this issue.
 - + B. It could be inferred that each processor uses only the information necessary. In one place, Gough says: "During lexical search . . . evidence suggests that the abstract phonemic representation is assigned the first lexical entry that can be found We have no evidence that disambiguation takes place until after lexical search."
- X. Memory
- + A. The only memory system suggested is primary memory, where some processing takes place.
 - B. TPWSGWYAU could perhaps be interpreted as a memory, but it seems to play no vital role in processing.
- XI. Levels of Proficiency
- A. Gough is very emphatic in stating that the model is a model of a proficient reader.
 - B. It would not be possible to add this to the model.
- XII. Types of Reading
- A. These are not provided for.
 - B. It would not be possible to add them to the model.

REFERENCES

- Gough, P. B. One second of reading. In H. Singer and R. B. Ruddell (Eds.), Theoretical models and processes of reading. Hillsdale, New Jersey: Erlbaum, 1980.
- Chomsky, N., & Halle, M. The sound pattern of English. New York: Harper and Row, 1968.

The Benchmarks of Reading and the
Goodman Model of Reading

- I. Eye Fixations and Movements
 - + A. The first cycle of Goodman's model is optical; here scanning and fixing take place.
 - + B. Prior predications of meaning, structures, graphic redundancy, and expectation of locus of key graphic cues are all listed as input to the sysle.
- II. Grapheme-Phoneme Recoding
 - + A. During the perceptual cycle, Goodman lists as one of the inputs "Cues from parallel phonological system (optional)."
- III. Word Recognition
 - + A. While "sampling-selection" is occurring during the perecptual cycle, the output is transmitted to feature analysis (cf. Smith, F. 1978). Feature analysis is also actively operating during the cycle.
- IV. Syntax and Semantics
 - + A. Syntax is the third cycle of Goodman's model; here he ties in strongly with deep structure.
 - + B. Semantics is alluded to as part of deep structure when referring to meaning.
- V. World Knowledge
 - + A. During the meaning cycle, an input from memory is "stored experience, conceptual constructs, lexicon."
 - + B. Goodman does not refer to what has been called pragmatic and textual knowledge. However, it could be argued that they are part of semantic memory. (cf. Shoben, 1980).
 1. Goodman, by adding stored experience as an input along with deep structure, alters the traditional notion of deep structure.
- VI. Interactivity
 - + A. This must be inferred from the model.
 1. This comes only by examining much of what he says and then interpreting his metaphores: "Each cycle melts into the next," "The readers leap toward meaning," and "The cycles are telescoped by strategies."
 2. "What the readers do results from limited but complex information sources and interactive but limited alternatives for their use."
- VII. Process Coordination
 - + A. Throughout all the cycles, Goodman refers to prediction.

This is an extremely important element in the model, as all processes function for only one of two purposes, to confirm or disconfirm the predictions made by the readers.

1. Prediction becomes, then, the coordinating element for the processes.
2. Goodman says, "A key assumption is that whatever the readers do is not random but is the result of the reading process"

VIII. Parallel Processing

- + A. Like interactivity, this can only be inferred from his metaphors of "melting" and "telescoping."

IX. Utilization

- + A. Goodman repeatedly stresses, "Readers are efficient in using the least amount of effort to achieve effectiveness," and "Efficient readers minimize dependence on visual detail."

X. Memory

- + A. Memory is an input to virtually every phase of every cycle and an output from many of them.

XI. Levels of Proficiency

- + A. Virtually every level of proficiency can be predicted and explained by the model.

XII. Types of Reading

- + Any type of reading can be described by the model.

REFERENCES

- Goodman, K. S., and Goodman, Y. Reading of American children whose language is a stable rural dialect of English or a language other than English. Final report for the U. S. Department of Health, Education, and Welfare, 1978.
- Shoben, E. J. Theories of semantic memory: Approaches to knowledge and sentence comprehension. In R. J. Spiro, B. C. Bruce, and W. F. Brewer (Eds.), Theoretical issues in reading comprehension. Hillsdale, New Jersey: Erlbaum, 1980.
- Smith, F. Understanding reading: A Psycholinguistic analysis of reading and learning to read. 2nd ed. Chicago: Holt, Rinehart, and Winston, 1978.